m_t dependence of HBT parameters in heavy ion collisions

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Study the two-particle correlation functions will shed light on the physics in heavy ion collisions [1] since the observed probability of two particles close to each other not only depends on their nature of quantum statistics but also on the collision dynamics, [2] specifically it depends on the space-momentum correlation. Experimental findings are that the extracted size parameters decreases as the transverse momentum increases. This was attributed to the hydro type collective flow that developed in heavy ion collisions. [3]

However, the dependence of the HBT size-parameters on transverse momentum has also been observed in $e^+ + e^-$ and $h + p$ collisions. [4] Those observations have shed strong doubt on the above explanation. In order to gain some insight on the issue, we study the pion correlation functions as a function of pair transverse momentum for three colliding systems: $p + p$, $Si + Si$, and $Au + Au$ central collisions at the RHIC energy. RQMD(v2.4) event generator was used to populate the events and an after-burner was used to make the correlation functions. Only pions from mid-rapidity ($|y| \leq 1$) are used in the study. The results are shown in the figure.

It can be see that the HBT size-parameters from all colliding systems are decreasing as p_t increases (filled symbols in the figure). In the longitudinal direction the rates of the decreasing are the same for all of the systems considered here, indicating that the behavior is driven by the initial condition. On the other hand, in the transverse direction, how fast the size-parameter decrease as a function of p_T depends on the size of the colliding system. Clearly, in high energy collisions, particle production implies space-momentum correlation which leads to the p_T dependence.[5] After the correlation is removed, by randomizing the space and momentum vector, the dependence disappears, see open symbols in the figure.

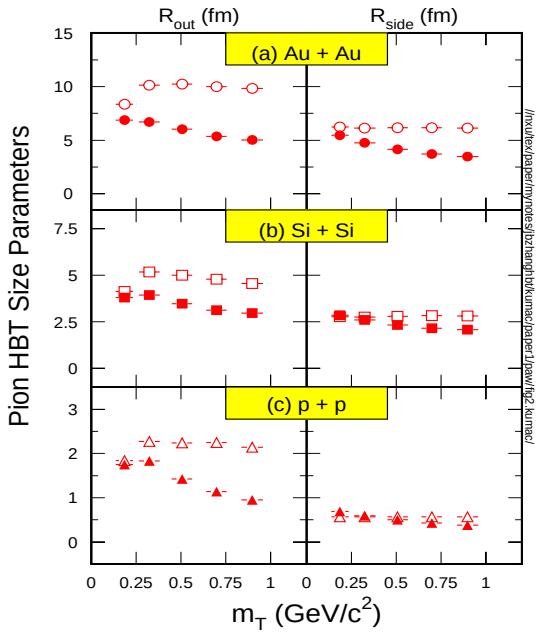

Figure 1: *The pion HBT size parameters R_{side} and R_{out} as a function of pair transverse mass m_T for $p + p$ (triangle), $Si + Si$ (square) and $Au + Au$ (circle) collisions at $\sqrt{s} = 200$ A GeV. The filled and open symbols represent the values extracted from normal events and transverse coordinates r_T and momentum p_T randomized events, respectively.*

Footnotes and References

[1] U.Heinz and B.Jacak, Ann. Rev. Nucl. Part. Sci. 49(1999).

[2] B.Monreal *et al.*, Phys. Rev. **C60**, R1901(1999).

[3] A. Makhlin and Yu. M. Sinyukov, Z. Phys. **C39**, 69(1988); H. Beker *et al.*, Phys. Rev. Lett. **74**, 3340(1995); T. Alber *et al.*, Z. Phys. **C66**, 77(1995)

[4] G. Alexander and I. Cohen, hep-ph/9909288, 1999; N. Agababyan, *et al.*, Phys. Lett. **B422**, 359(1998)

Footnotes and References

[5] The detailed dynamics for the correlation may be different: for elementary collisions, it may arise at the hadronization while for heavy ion collisions, it comes from the combination of the hadronization and late stage hadronic rescatterings.